

Name: _____ Date: _____ Period: _____

Student Exploration: Titration

Go to www.explorelarning.com and launch the "Titration" gizmo.

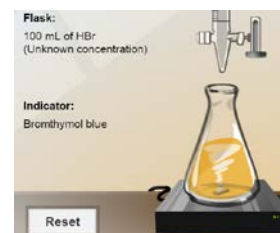
Prior Knowledge Questions:

1. How does **Bromthymol blue** indicate whether a substance is an acid, a neutral or a base?

2. How does **Methyl orange** indicate whether a substance is an acid, a neutral or a base?

3. How does **Phenolphthalein** indicate whether a substance is an acid, a neutral or a base?

Gizmo Warm-up: To begin, check that **1.00 M NaOH** is selected for the **Burette**, **Mystery HBr** is selected for the **Flask**, and **Bromthymol blue** is selected for the **Indicator**.



4. Look at the flask. Based on the color of the flask HBr must be a(n) _____
5. What does this tell you about the pH of the solution in the flask? _____

Solutions with a pH below 7.0 are acidic, while those with a pH above 7.0 are basic

6. Move the slider on the burette to the top to add about 10 mL of NaOH to the flask. What happens, and what does this tell you about the pH of the flask? _____
7. Move the slider on the burette to the top to add about 20 mL of NaOH to the flask. What happens, and what does this tell you about the pH of the flask? _____
8. Move the slider on the burette to the top to add about 25 mL of NaOH to the flask. What happens, and what does this tell you about the pH of the flask? _____

Measure: A **titration** can be used to determine the concentration of an acid or base by measuring the amount of a solution with a known concentration, called the **titrant**, which reacts completely with a solution of unknown concentration, called the **analyte**. The point at which this occurs is called the **equivalence point**.

Click **Reset** and Carefully add NaOH into the flask until the Bromthymol blue begins to change its color. Stop adding NaOH when the color change is permanent.

9. How much (NaOH) was required to cause the indicator to change color? _____
10. What can you say about the pH before and after the last drop of NaOH was added? _____

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Question: Why did we do this thing called titration???

Now that you know how much 1.00 M NaOH is needed to neutralize the HBr solution (your answer to #9) we can **calculate the concentration** of the mystery HBr.

Calculate: Select the **Worksheet** tab. This tab helps you calculate the analyte concentration.

The screenshot shows a window titled "DESCRIPTION WORKSHEET". Inside, it asks "M HBr = ?". Below this is a calculation template:
$$= \frac{\text{moles HBr}}{\text{moles NaOH}} \times \frac{\text{mL NaOH}}{\text{mL HBr}} \times \text{M NaOH}$$
 Each term in the equation has a corresponding input box. The "moles HBr" and "moles NaOH" boxes contain the number "1". At the bottom of the window are three buttons: "Calculate", "Check", and "Clear".

- Fill in the first set of boxes (“moles HBr” and “moles NaOH”) based on the coefficients in the balanced equation found under the calculation section of the Gizmo. (If there is no coefficient, the value is 1....so type in 1’s for these boxes for this example :)
- Record the appropriate volumes in the “mL NaOH” and “mL HBr” boxes. In other words, what was your answer to #9 and how much liquid is in the flask?
- Record the concentration of the titrant in the M NaOH box. You can find this number on the Gizmo, either back in the description or under the Burette measurements.

11. Click **Calculate**. What is the concentration listed? _____

Click **Check**. Is this the correct concentration?

If you get an error message, revise your work until you get a correct value. (You may have to redo the titration if you do not have the correct volume of titrant.)

Practice: Perform the following titrations and determine the concentrations of the following solutions. In each experiment, list the volume of titrant needed to neutralize the analyte and the indicator used. Use the **Worksheet** tab of the Gizmo to calculate each analyte concentration. Include all units.

Titrant (The stuff in the Burette)	Analyte (The mystery stuff)	Indicator	Titrant volume (How much came out of the Burette?)	Analyte concentration (use the worksheet tool and check your work)
0.70 M KOH	HBr	Bromthymol Blue		
0.80 M H ₂ SO ₄	CH ₃ COOH	Phenolphthalein		
0.50 M HCl	NaOH			
Challenge 1 M NaOH	H ₂ SO ₄			